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(54) Improvements in or relating to a moisture sensor

(57) A moisture sensor consists of an elongate element 1 of absorbent material such as wood. Two opposed faces 2 of the element are each provided with a conductive coating layer, e.g. of silver paint, these layers being connected to the two conductors 4, 5 of a cable 3. The sensor is substantially encapsulated within a sleeve 7 of plastics material which leaves the end face 9 of the element exposed.

FIG 2

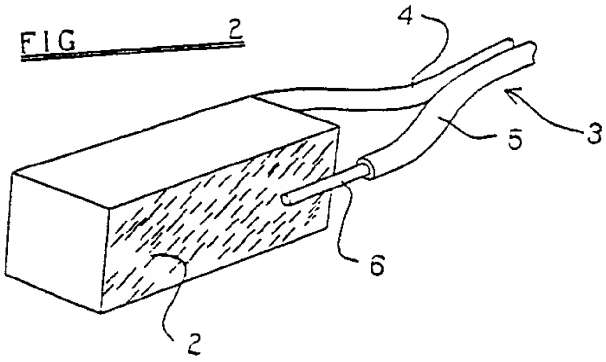


FIG 1

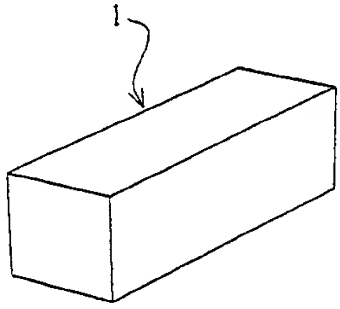
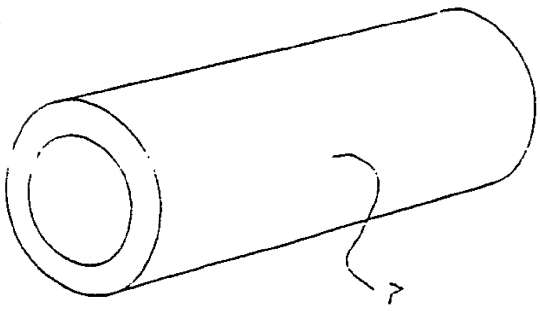


FIG 3



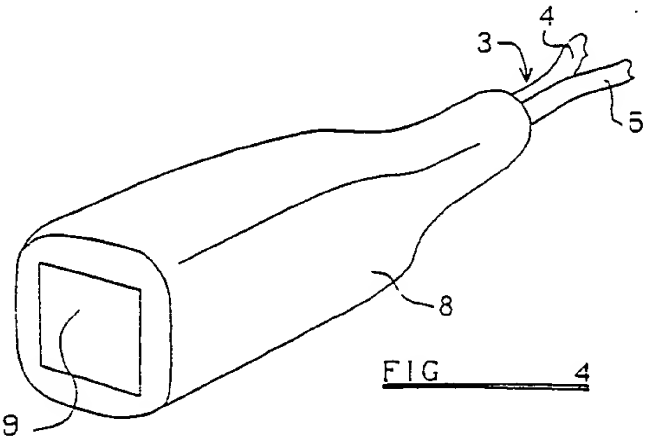


FIG 4

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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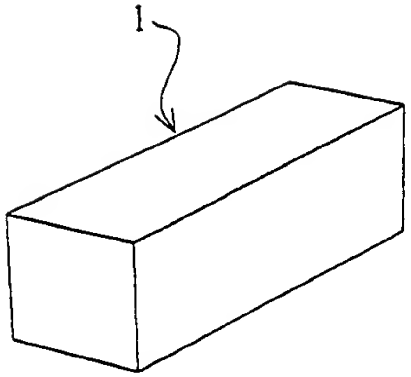

FIG 1

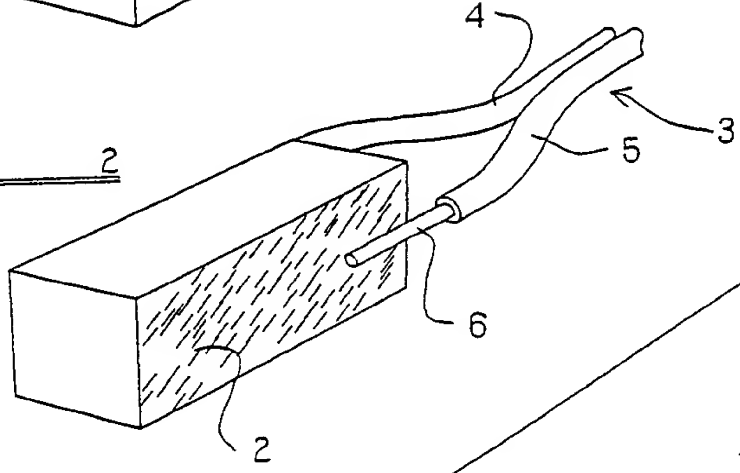

FIG 2

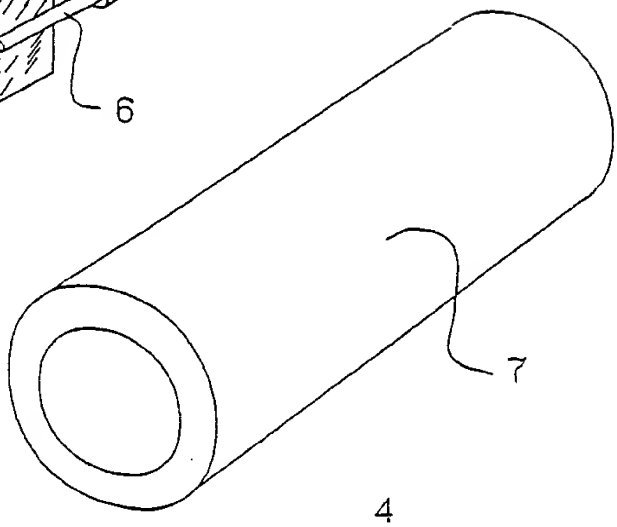

FIG 3

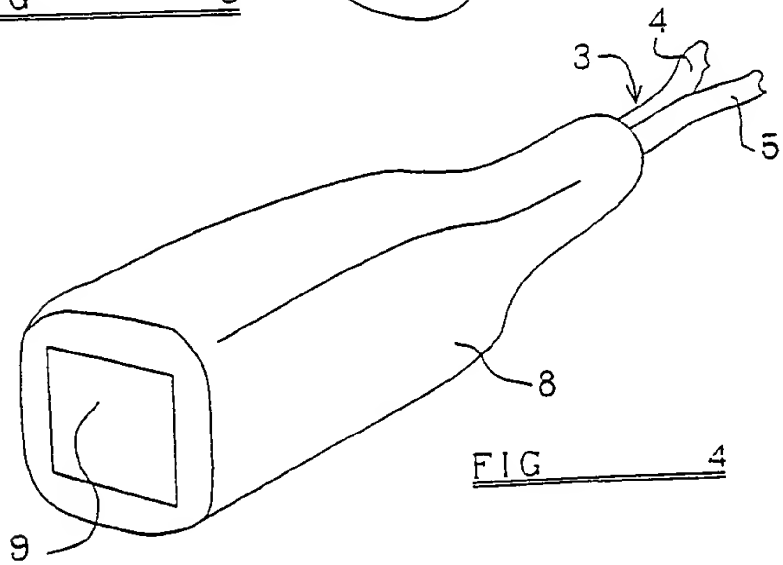

FIG 4

Description of Invention

"Improvements in or relating to a moisture sensor"

THE PRESENT INVENTION relates to a moisture sensor and more particularly to a moisture sensor adapted to be used to sense the moisture content within wood, although the sensor of the invention may find other applications.

It is to be appreciated that the performance and durability of wood is dependent upon its moisture content. It is thus desirable to be able to measure the moisture content of wood.

Many moisture meters have been proposed previously which can measure the moisture content of wood, but most of these meters rely on inserting two prongs or electrodes into the wood, and then measuring the electrical resistance between the prongs or electrodes.

Such a technique is very prone to error, since the electrical resistance between the prongs depends upon the degree of insertion into the wood, the nature of any paint provided on the exterior of the wood, and many other similar factors. Also such moisture meters can only be used to determine the moisture of wood where access can be gained to the surface of the wood.

The present invention seeks to provide an improved moisture sensor.

According to this invention there is provided a

moisture sensor, the sensor comprising an element of moisture absorbent material presenting two opposed faces, the two opposed faces being provided with conductive material extending over a predetermined area thereof, there being a cable having two conductors which are connected respectively to the areas of conductive material, the sensor being adapted to be exposed to an environment, the moisture level of which is to be sensed.

Preferably the sensor is substantially encapsulated within an electrically insulating material.

Conveniently the said element is of elongate form presenting two opposed elongate faces which are provided with said electrically conducting material.

Advantageously an end face of the elongate element is exposed by the encapsulation.

Preferably the electrically conducting material is in the form of a conductive paint.

Conveniently the conductive material is a silver paint.

Preferably the wires of the cable are secured or bonded to the conductive material.

Conveniently the said absorbent material is wood.

Advantageously the said element of absorbent material has a size which is approximately 1.8mm by 1.8mm by 8mm.

Preferably the protective encapsulation is in

the form of a heat-shrunk sleeve of plastic material which covers the said conductive material.

The invention also relates to the use of a sensor as described above with a moisture meter, or moisture monitor. The sensor may be interrogated by a micro-processor or may be interrogated over a telephone line or the like by a remote computer.

In order that the invention may be more readily understood, and so that further features thereof may be appreciated, the invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a view of a sensor strip to be used in a sensor in accordance with the invention,

FIGURE 2 shows the sensor strip of Figure 1 with wires attached,

FIGURE 3 shows a heat shrinkable sleeve, and

FIGURE 4 shows the assembled sensor.

A moisture sensor in accordance with the invention has a sensor strip 1 which is formed from an appropriate element of a moisture absorbent material, such as wood. The wood may be any appropriate wood, but is preferably a uniform close-grained wood, so that sensor strips for sensors in accordance with the invention may be substantially uniform. The strip 1 is an elongate strip of square cross-section. The strips may be cut to have approximately the desired size and the strips may then be brought to an accurate size by dry sanding or abrading. This will also remove splinters. It has been found that the sensor strip 1 may suitably have a final

size of 1.8mm by 1.8mm by 8mm. Of course, this is one example of a size that may be used for em bodiments of the invention, but other sizes may prove to be adequate, be they larger or smaller.

It is to be understood that the moisture content of the wood strip must be monitored and controlled, so that accurate dimensions for the finished sensor may be obtained. Preferably the strip should have a uniform moisture content of between 6 and 9 percent.

When the sensor strip 1 has been fabricated to the desired size, two opposed elongate faces 2 which may be termed "radial" faces, are painted with electrically conductive silver paint. Any appropriate silver paint may be used, such as ALTA 1 electrically conductive paint (Catalogue number 1 SECP). Only one of the faces 2 coated with silver paint is visible in Figure 2. Care is taken to remove silver paint from all the other faces, or preferably to ensure that none of the paint is applied to the other faces. A cable 3 having two conductive wires 4,5, is taken and the end portions 6 of the wires are bared, and the bared wires are then placed in contact with the respective silver painted faces 2 of the sensor strip 1, and clamped in position. The bared wires become bonded or adhered to the silver paint as it dries. For example approximately 6.5 mm of bare wire may be bonded to each silver painted face 2 of the sensor strip 1.

Finally, the sensor is encapsulated in a strong electrically insulating water impermeable material. Thus, for example, a sleeve 7 of heat shrinkable plastics material is mounted on the assembly thus fabricated, to cover the entire length of the sensor strip 1, and to cover part of the cable 3. The sleeve 7 is then heat-shrunk into position, to form an encapsulation 8.

This substantially encapsulates the sensor, whilst leaving an end face 9 of the sensor strip 1 exposed, the rest of the sensor being substantially sealed. The sensor may be trimmed to the desired length by cutting back the exposed face 9.

The fabricated sensor element is then permitted to reach an equilibrium moisture condition. This may be achieved by leaving the sensor within a standard environment for a specific period of time. The sensor element may then be connected to a resistance meter or moisture meter to check that the sensor element reads within a predetermined tolerance band.

It is to be appreciated that the electrical resistance of the sensor follows the equation:

$$R = r \frac{d}{A}$$

where

R = electrical resistance ohms
r = electrical resistivity, ohm/mm,
d = is the distance between the electrodes in mm
A = is the area of each electrode in square mm.

It is possible to calibrate the sensor with regard to moisture content, the resistivity of the wood of the sensor varying with the moisture content of the wood.

A sensor element in accordance with the invention may be located permanently or semi-permanently in position in a piece of wood, the moisture content of which is to be monitored, with the cable 3 being accessible to a moisture meter. The sensor element 1 may thus

be located in a position which ordinarily would not be accessible. Thus the sensor of the present invention may be utilised with a moisture meter which can be releasably and reliably connected to the cable 3 with greater facility than the conventional moisture meter which involves the insertion of pins into the wood work. It is to be appreciated that the sensor of the invention may be located in position when a wooden structure is fabricated, and the cable 5 may come to a termination at a suitable place, thus meaning that decorations need not be damaged when the moisture level of wood is to be determined.

Alternatively, the sensor may be connected to a device with which it forms a moisture monitor, such as a micro-processor, which can effectively take readings of moisture level by interrogating the sensor from time-to-time. The measured readings may be recorded, and an alarm may be activated, or some device operated (such as a ventilating fan) if the measured value exceeds a predetermined limit, or is outside an acceptable range.

Such a micro-processor can be pre-programmed appropriately in accordance with the particular conditions under which the sensor is to be used.

The sensor may be interrogated from a remote location, for example over telephone lines, by a central computer.

It is to be appreciated that the heat-shrunk sleeve provides the sensor with protection against physical damage or contamination when it is inserted into position. It has been found that the encapsulation controls the response time of the sensor. Encapsulation of the sensor with the heat-shrunk sleeve makes possible

a minature sensor of robust construction capable of withstanding physical and thermal abuse without loss of performance.

The provision of the heat shrunk sleeve also serves to isolate or insulate the sensor element electrically from the material in which it is installed, thus ensuring that the resistivity readings that are taken are taken solely across the sensor element. This allows the sensor element to be used in any type of material without any need for re-calibration.

It is to be appreciated that the material forming the strip of the sensor is preferably wood, as described, but this need not be so, since any appropriate absorbent material with the requisite properties can be utilised.

The surface area of the sensor strip 1 that is exposed to the environment that is to be sensed can be controlled by the encapsulation established by the heat shrunk sleeve 8. Whilst in the described embodiment the entire end face 9 of the strip is exposed, a lesser area may be exposed if desired.

In alternative embodiments of the invention the bare wires may be adhered to the silver painted faces 2, when they have dried, using a cellulose acetate glue or other appropriate adhesive. The encapsulation may be provided in other ways, for example by dipping the sensor into molten plastic, and then cutting back to expose the end face 9. Other techniques may also be used.

It is to be appreciated that the sensor is very small, and thus the sensor may be located in very small places. Also the sensor, since it is encapsulated, may

be handled easily.

Whilst the invention has been described with reference to the use of the sensor primarily to sense the moisture level present in timber, the sensor may be used to sense the moisture level present in the atmosphere, in a confined space, or in materials other than timber.

CLAIMS:

1. A moisture sensor, the sensor comprising an element of moisture absorbent material presenting two opposed faces, the two opposed faces being provided with conductive material extending over a predetermined area thereof, there being a cable having two conductors which are connected respectively to the areas of conductive material, the sensor being adapted to be exposed to an environment, the moisture level of which is to be sensed.

2. A sensor according to Claim 1 wherein the sensor is substantially encapsulated within an electrically insulating material.

3. A sensor according to Claim 1 or 2 wherein the said element is of elongate form presenting two opposed elongate faces which are provided with said electrically conducting material.

4. A sensor according to Claim 3 as dependent upon Claim 2 wherein an end face of the elongate element is exposed by the encapsulation.

5. A sensor according to any one of the preceding Claims wherein the electrically conducting material is in the form of a conductive paint.

6. A sensor according to Claim 5, wherein the conductive material is a silver paint.

7. A sensor according to any one of the preceding Claims, wherein the wires of the cable are secured or bonded to the conductive material.

8. A sensor according to any one of the preceding Claims, wherein the said absorbent material is wood.

9. A sensor according to any one of the preceding Claims, wherein the said element of absorbent material has a size which is approximately 1.8mm by 1.8mm by 8mm.

10. A sensor according to Claim 2 or any Claim dependent thereon, wherein the protective encapsulation is in the form of a heat-shrunk sleeve of plastic material which covers the said conductive material.

11. A sensor substantially as herein described with reference to and as shown in the accompanying drawings.

12. The use of a sensor according to any one of the preceding Claims with a moisture meter or a moisture monitor.

13. The use of a sensor according to Claim 12 wherein the sensor is interrogated by a micro-processor.

14. The use of a sensor according to Claim 12 wherein the sensor is interrogated over a telephone line or the like by a remote computer.

15. Any novel feature or combination of features disclosed herein.

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